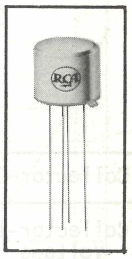
RCA RF TRANSISTORS
Low-Noise VHF/UHF "Forward-AGC" Type

2N4081

File No. 271

SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR



JEDEC TO-104

For Low-Noise VHF/UHF Applications in Industrial and Military Equipment Requiring "Forward-Bias" AGC

RCA 2N4081* is an epitaxial planar transistor of the silicon n-p-n type, with characteristics which make it very useful as a low-noise rf amplifier at frequencies up to 500 MHz. The 2N4081 is particularly useful for applications employing "forward-bias" AGC.

The RCA 2N4081 employs a New Terminal Arrangement in which the emitter and base connections are interchanged to provide maximum isolation between the output (collector) and the input (base) terminals. Although this new basing configuration does not appreciably change the measured device feedback capacitance, it permits the use of external inter-terminal shields to reduce the feedback due to external capacitances, particularly on printed circuit boards. This feature makes it possible to achieve greater circuit stability or higher useable gain per stage in critical circuit designs.

RCA 2N4081 features very low feedback capacitance, low noise, and high useful power gain. The high-temperature capability of this silicon device permits operation up to 200° C junction temperature.

RCA 2N4081 utilizes a hermetically sealed JEDEC TO-104 metal case which is electrically isolated from the transistor electrodes. The case is provided with a separate lead which may be grounded to minimize collector-to-base interlead capacitance and coupling to other circuit components.

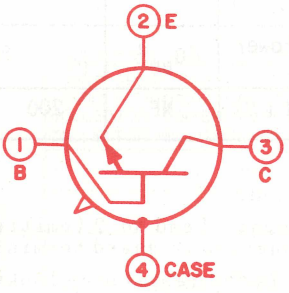
* Formerly Developmental No. TA-2860

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	40 max	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	40 max	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	3 max	V
COLLECTOR CURRENT, I_C	limited by dissipation	
TRANSISTOR DISSIPATION, P_T.		
At ambient temperatures: Up to 25° C	200 max	mW
Above 25° C	derate linearly at 1.14	mW/°C
TEMPERATURE RANGE:		
Storage	-65 to +200	°C
Operating (junction)	-65 to +200	°C
LEAD TEMPERATURE (During Soldering):		
At distances ≥ 1/16 inch from seating surface for 10 seconds max	265	°C

FEATURES

- New Terminal Arrangement — for superior high-frequency performance



Bottom View

1 - Base
2 - Emitter
3 - Collector
4 - Case

- controlled forward AGC characteristics — gain reduction (ΔG_{pe}) = 30 dB min for change in I_C from 2 mA to 11 mA
- low noise figure — NF = 3.5 dB max. at 200 MHz
- very low collector-to-base feedback capacitance — C_{cb} = 0.25 pF max.
- high unneutralized power gain — G_{pe} = 19 dB min. at 200 MHz
- hermetically sealed JEDEC TO-104 metal package

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

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Printed in U.S.A.
2N4081 5-67

ELECTRICAL CHARACTERISTICS, *At a Ambient Temperature (T_A) of 25°C*

Characteristics	Symbol	TEST CONDITIONS					LIMITS			Units
		Frequency f	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Emitter Current I_E	DC Collector Current I_C	Type 2N4081			
		MHz	V	V	mA	mA	Min.	Typ.	Max.	
Collector-Cutoff Current	I_{CBO}	-	10	-	0	-	-	-	0.02	μA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	-	-	-	0	0.001	40	-	-	V
Collector-to-Emitter Breakdown Voltage $I_B = 0$	$V_{(BR)CEO}$	-	-	-	-	1	40	-	-	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CES}$	Emitter-Base Termination Shorted				0.001	40	-	-	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	-	-	-	-0.01	0	3	-	-	V
Static Forward Current-Transfer Ratio	h_{FE}	-	-	10	-	2	40	-	180	-
Magnitude of Small-Signal Forward Current Transfer Ratio	$\lvert h_{fe} \rvert$ [a]	1 kHz	-	10	-	2	40	-	200	-
		100	-	10	-	2	6	-	11	-
Collector-to-Base Feedback Capacitance	C_{cb} [b]	0.1 to 1	10	-	0	-	-	-	0.25	pF
Small-Signal, Common-Emitter Power Gain in Unneutralized Amplifier Circuit (See *Fig.1*)	G_{pe} [a,d]	200	-	10	-	2	19	-	24	dB
Reduction in Small-Signal Power Gain with AGC (See *Fig.1*)	ΔG_{pe} [a]	For change in I_C from 2 mA to 11 mA					30	-	-	dB
Noise Figure [a,e] (See *Figs. 1 & 2*)	NF	200	R_S [c] = 200Ω	10	-	2	-	-	3.5	dB

[a] Lead No.4 (case) grounded.

[b] Three-terminal measurement: Lead No.2 (emitter) and lead No.4 (case) connected to guard terminal.

[c] R_S (Source Resistance) is the resistance looking back from the base terminal (1) toward the generator input.

[d] Power Gain (G_{pe}) value given was obtained by adjusting circuit tuning for maximum power output.

[e] Value of Noise Figure (NF) given was obtained by tuning the input circuit of Fig.1 for minimum NF. This tuning results in a value of Power Gain (G_{pe}) which is typically 1.5 dB lower than that obtained by tuning as in (d) above.

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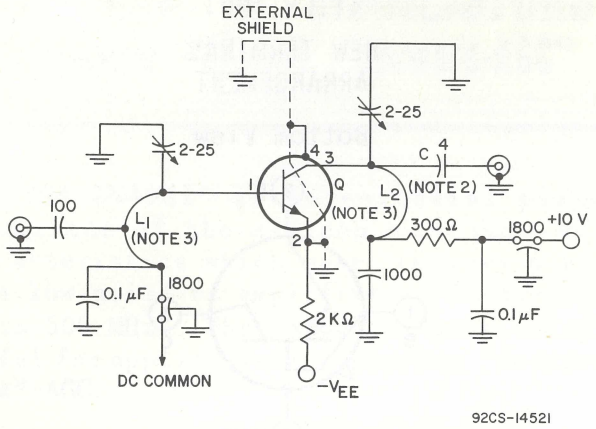


Note 1: All capacitances in pF except where noted.

Note 2: Effective value of C from the collector terminal to the output connector is 4 pF. The actual capacitor is a ceramic button type with 7/8" lead length and labeled capacity of 3.3 pF.

Note 3: L_1 - 1/2 turn #14 AWG: Center-Tapped; total length = 2 inches.

L_2 - 1/2 turn #14 AWG: total length = 1-1/2 inches.

Q = 2N4081

Fig. 1 - 200-MHz Power Gain and Noise Figure test circuit for 2N4081.

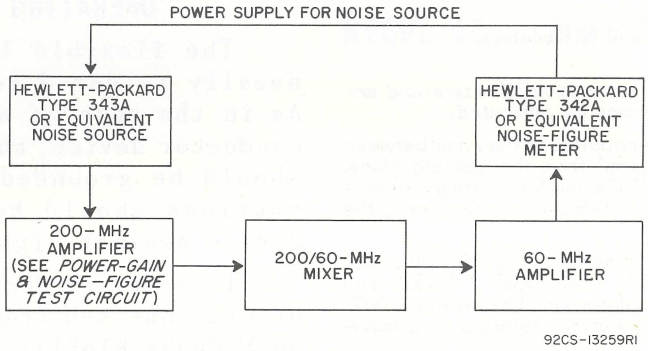

POWER SUPPLY FOR NOISE SOURCE
HEWLETT-PACKARD TYPE 343A OR EQUIVALENT NOISE SOURCE
HEWLETT-PACKARD TYPE 342A OR EQUIVALENT NOISE-FIGURE METER
200-MHz AMPLIFIER (SEE POWER-GAIN & NOISE-FIGURE TEST CIRCUIT)
200/60-MHz MIXER
60-MHz AMPLIFIER
92CS-13259RI

Fig. 2 - Block diagram of Noise-Figure test circuit for 2N4081.

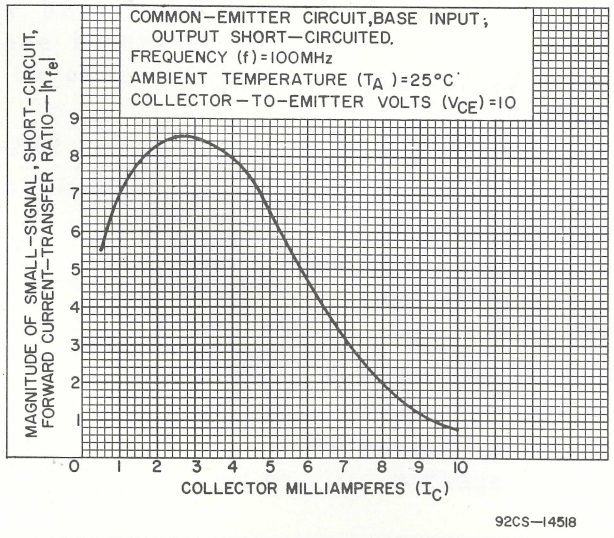

COMMON-EMITTER CIRCUIT, BASE INPUT; OUTPUT SHORT-CIRCUITED.
FREQUENCY (f) = 100MHz
AMBIENT TEMPERATURE (T_A) = 25°C
COLLECTOR-TO-EMITTER VOLTS (V_{CE}) = 10
MAGNITUDE OF SMALL-SIGNAL, SHORT-CIRCUIT, FORWARD CURRENT-TRANSFER RATIO — $|h_{fe}|$
0 1 2 3 4 5 6 7 8 9 10
COLLECTOR MILLIAMPERES (I_C)
92CS-14518

Fig. 3 - Typical Magnitude of Small-Signal Beta characteristic for 2N4081.

TYPICAL Y-PARAMETER CHARACTERISTICS AS FUNCTIONS OF COLLECTOR CURRENT FOR 2N4081

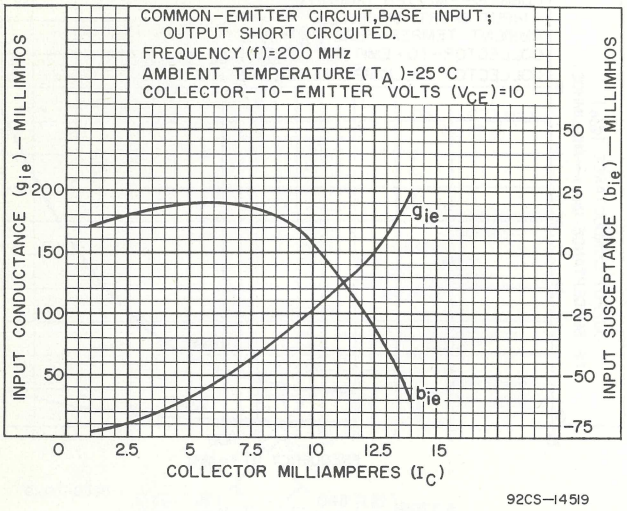


Fig.4 - Y_{ie} vs I_C

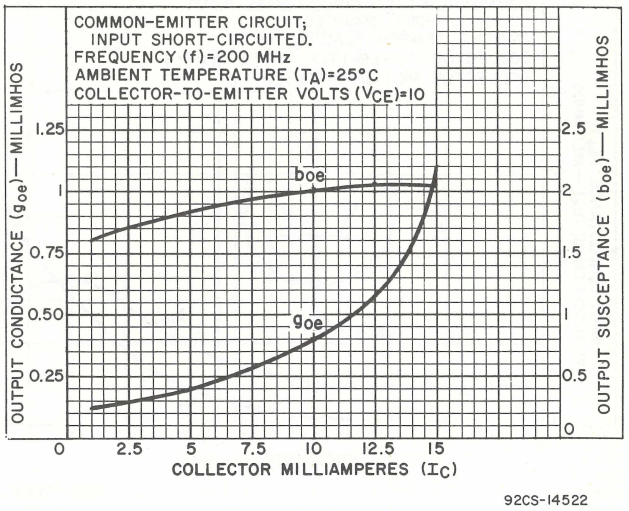


Fig.5 - Y_{oe} vs I_C

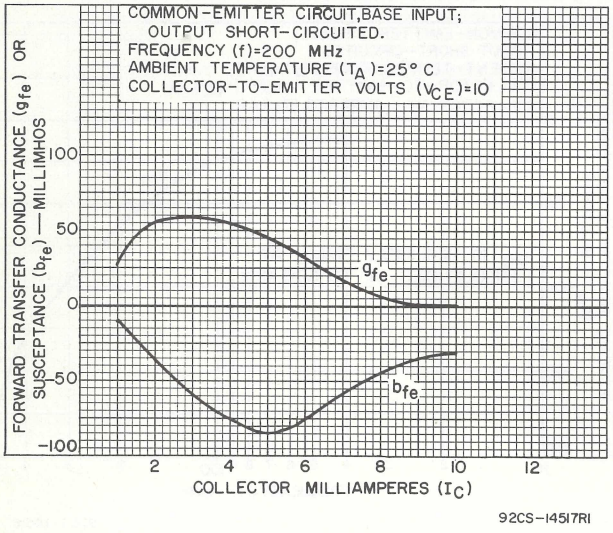


Fig.6 - Y_{fe} vs I_C

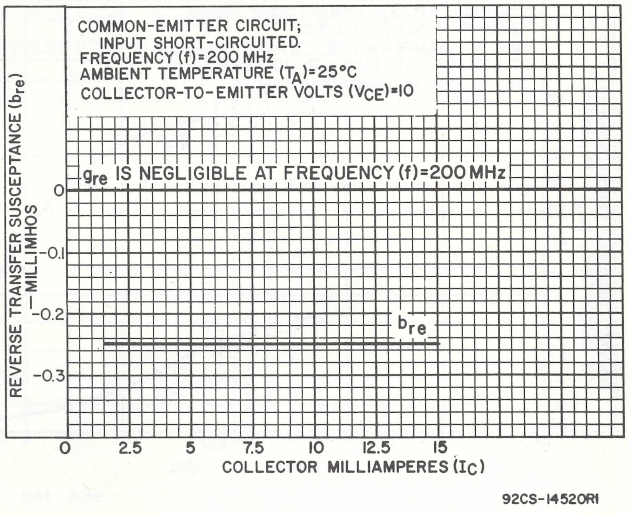


Fig.7 - Y_{re} vs I_C

TYPICAL Y-PARAMETER CHARACTERISTICS AS FUNCTIONS OF FREQUENCY FOR 2N4081

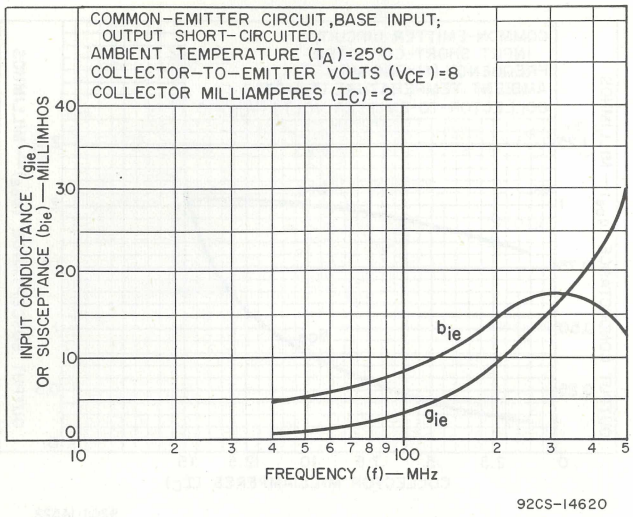


Fig.8 - Y_{ie} vs f

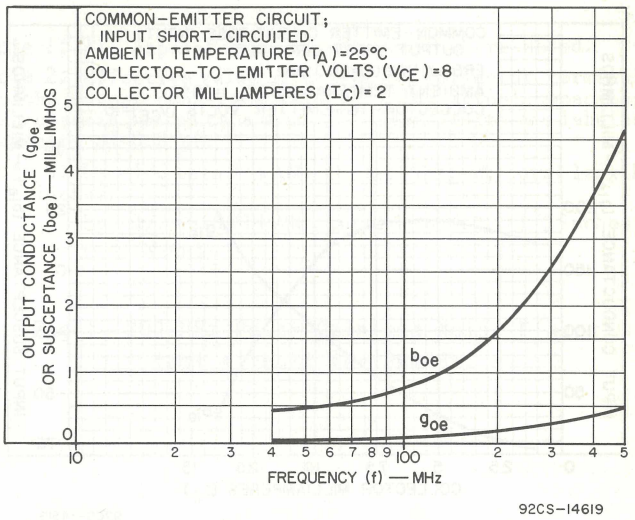


Fig.9 - Y_{oe} vs f

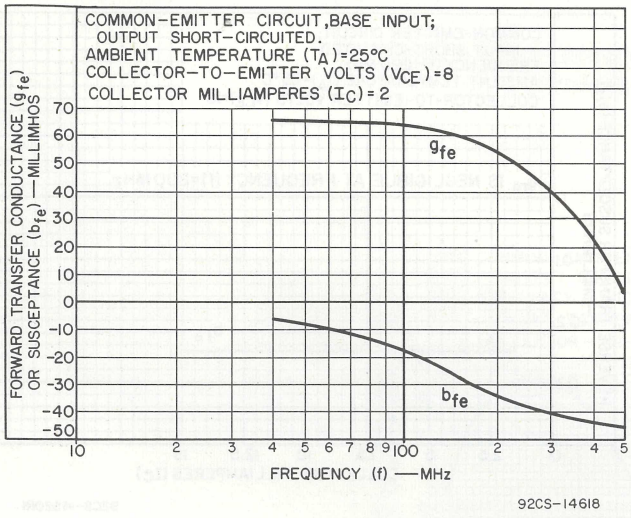


Fig.10 - Y_{fe} vs f

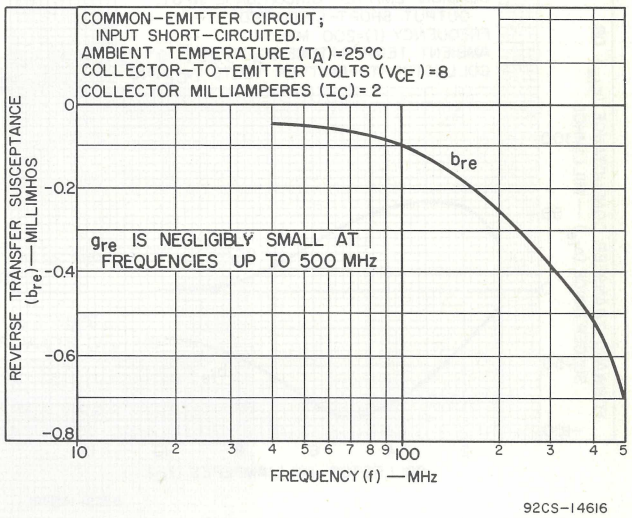
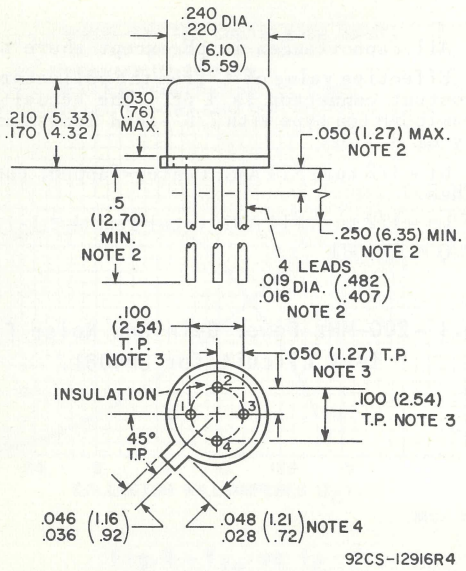


Fig.11 - Y_{re} vs f

DIMENSIONAL OUTLINE
TO-104



Dimensions in Inches and Millimeters

Note 1: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

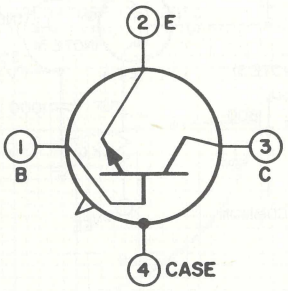
Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250" (6.35 mm) from the seating plane. From 0.250" (6.35 mm) to the end of the lead a maximum diameter of 0.021" (0.533 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019" (0.482 mm) at a gauging plane of 0.054" (1.372 mm) +0.001" (0.025 mm) -0.000" (0.000 mm) below seating plane shall be within 0.007" (0.177 mm) of their true position (location) relative to a maximum width of tab.

Note 4: Measured from actual maximum diameter.

ATTENTION!
NEW TERMINAL ARRANGEMENT

Bottom View



1 - Base 3 - Collector

2 - Emitter 4 - Case

OPERATING CONSIDERATIONS

The flexible leads of the 2N4081 are usually soldered to the circuit elements. As in the case of any high-frequency semiconductor device, the tips of soldering irons should be grounded, and appropriate precautions should be taken to protect the device against high electric fields.

This device should not be connected into or disconnected from circuits with the power on because high transient voltages may cause permanent damage to the device.